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A Unique Engraved Shale Pendant from the Site of Star Carr: the oldest Mesolithic art in Britain

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Summary



In 2015 an engraved shale pendant was found during excavations at the Early Mesolithic site of Star Carr, UK. Engraved motifs on Mesolithic pendants are extremely rare, with the exception of amber pendants from southern Scandinavia. The artwork on the pendant is the earliest known Mesolithic art in Britain; the 'barbed line' motif is comparable to styles on the Continent, particularly in Denmark. When it was first uncovered the lines were barely visible but using a range of digital imaging techniques it has been possible to examine them in detail and determine the style of engraving as well as the order in which the lines might have been made. In addition, microwear and residue analyses were applied to examine whether the pendant showed signs that it had been strung or worn, and whether the lines had been made more visible through the application of pigments, as has been suggested for some Danish amber pendants. This approach of using multiple scientific and analytical techniques has not been used previously and provides a methodology for the examination of similar artefacts in the future.

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Features

- Key Words: Star Carr; Yorkshire; Mesolithic; art; pendant; RTI; SEM; use wear; amulet; engraving
- Publication date: 26 February 2016
- This article contains a [3D viewer](#), [RTI viewer](#), links to related [digital archive](#), [.STL file](#) for 3D printing.
- Related digital archive: [Star Carr Archives Project](#) hosted by the Archaeology Data Service.
- The development and publication costs of this article were paid for by the Department of Archaeology, University of York.



This article explores ways to develop communication of archaeology for differing audiences, one of the aims of the [NEARCH project](#) under the EU [Culture](#) programme.

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1. Introduction

During the 2015 excavation season at Star Carr (Figure 1), a shale pendant with lines engraved into it was found in the lake edge deposits. When the artefact was first uncovered it was thought to be a natural piece of stone: the perforation was full of sediment and the engravings were not visible. On lifting, the sediment fell away from the hole and, on closer inspection, faint engravings became visible on one side.



Figure 1: Photograph of the pendant showing the faint engravings

Although shale beads, a piece of perforated amber, bird bone and two perforated animal teeth have been recovered from Star Carr (Clark [1954](#); Milner *et al.* [2013a](#)), this latest discovery represents the first perforated artefact with an engraved design. The art is typical for this period, in its geometric design associated with small portable objects (Płonka [2003](#)). Other pendants are known from northern Europe, in particular, Denmark (Fischer and Vang Petersen [forthcoming](#) ; Toft and Brinch Petersen [2016](#);

Vang Petersen [2016](#)), but an engraved pendant is unique for Britain. Furthermore, to our knowledge, no other Mesolithic engraved pendants from Europe are made of shale: the predominant material used being amber, antler and bone (Andersen [2001](#); Gramsch [2014](#)); however, an engraved stone pendant has been found from Brunstad, Norway (Schülke [2015](#)).

Grahame Clark, the original excavator at Star Carr (Clark [1954](#)), did not find any engravings like this at the site. He was, however, an expert on the art found in Europe and wrote a comprehensive chapter on the art of the Maglemose culture (the Early Mesolithic) in his book on the Mesolithic settlement of Northern Europe (Clark [1936](#)). It is therefore unfortunate that the engraved pendant was found less than a metre from the end of Clark's Cutting II (Figure 2) and that he did not have the chance to study this piece. The area where the pendant was discovered is where Clark found a large quantity of bone, antler and wood, including rare artefacts such as 21 headdresses made from red deer skulls and 191 antler barbed points; the pendant appears to be from the same detrital muds and is therefore broadly associated with these other finds (Figure 2).



Figure 2: Location of the

find. The detail of Clark's excavations is taken from the plan as published in the 1954 monograph with details of the birch tree and 'birch brushwood platform' associated with a large quantity of bone, antler and flint. The gap in Clark's plan of the brushwood is an area that was not planned but which also contained these finds and, similarly, much of the rest of Clark's excavation produced large quantities of material but plans for this area do not exist

The small size of the pendant and the faint nature of the artwork necessitated the application of a range of techniques in order to gain high resolution imaging for a better understanding of the creation of the lines: Reflectance Transformation Imaging (RTI), white light 3D scanning, light microscopy, and scanning electron microscopy (SEM). The pendant has been examined under low and high power microscopes for use-wear traces that might indicate whether it had been strung or used. It has also been suggested by Clark ([1936](#), 162, footnote 1) that patterns on such objects may have been made visible by rubbing in a darker substance 'as is done by Esquimaux in rather similar incised bone-work' and it has been noted that black birch bark pitch was used to infill the designs of the Danish amber pendants (Toft and Brinch Petersen [2016](#); Vang Petersen [2016](#)), as well as antler and bone (Malmer and Magnusson [1955](#)).

Therefore, we have examined the artefact for *in situ* organic residues using reflected light microscopy and Micro-Raman spectroscopy.

This article presents the results of these investigations and places the pendant into the wider context of European Mesolithic portable artwork. Finally, we examine our data in order to produce a biographical account of the use-life of this object which saw it being deposited, perhaps ritually, in the water at the lake edge.

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2. Background to the Site

Star Carr is one of a number of Early Mesolithic sites that have been recorded around palaeo-Lake Flixton, in the eastern Vale of Pickering, North Yorkshire, UK (Figure 3). The palaeo-lake formed at the start of the Windermere Interstadial (c. 12,700-10,800 cal BC), a warm phase at the end of the last Ice Age, and it persisted as a water body until the end of the Mesolithic (c. 4000 cal BC).

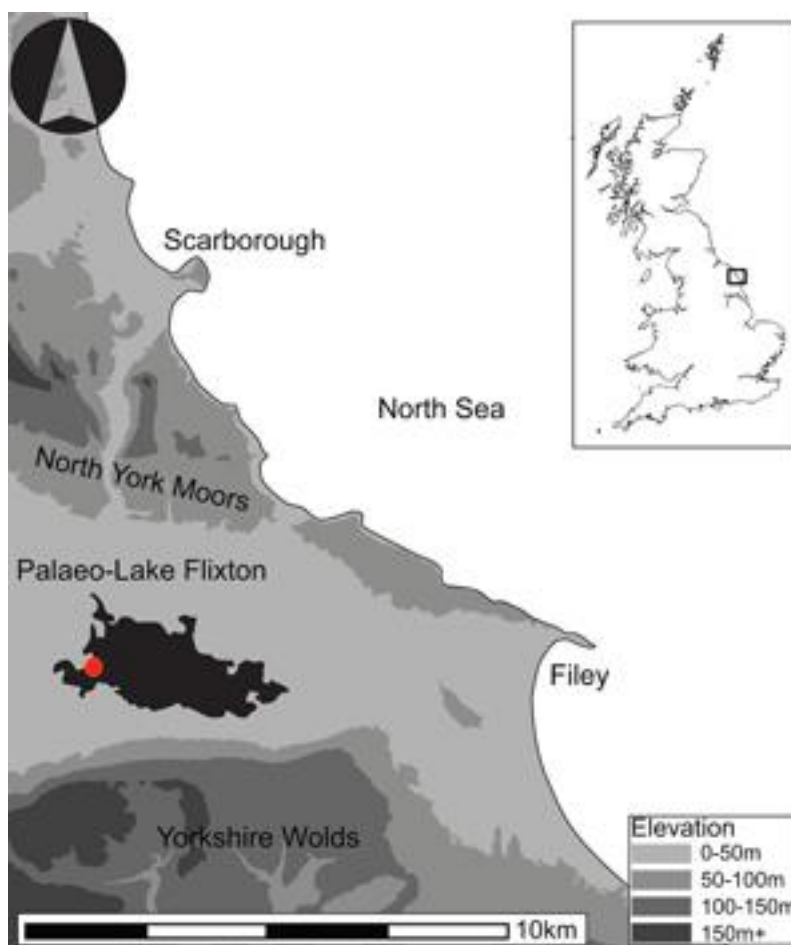


Figure 3: Location map of Star Carr: Star Carr was found on what would have been the edge of a lake, now known as palaeo-Lake Flixton

John Moore, a local amateur archaeologist, first carried out investigations in the area from 1947 (Clark [1954](#), xvii) and identified 10 sites around the lake. Moore excavated a trench at Star Carr in 1948, and from 1949-1951 Grahame Clark from the University of Cambridge conducted three further seasons of fieldwork (Clark [1954](#)). Further work in the area has been carried out since the 1980s by the Vale of Pickering Research Trust in order to map the extent of the lake and discover further sites (Milner *et al.* [2011](#)). Since 2004, NM, CC and BT have been co-directing excavations at Star Carr (Conneller *et al.* [2012](#); Milner *et al.* [2013b](#)). In 2012 the POSTGLACIAL project commenced: this is a five year, European Research Council funded project aiming 'To implement an interdisciplinary, high-resolution approach to understanding hunter-gatherer lifeways within the context of climate and environment change during the early part of the post-glacial period (c. 10,000-8000 BC)'. In order to address this aim, excavations have been carried out at Star Carr over three seasons from 2013-2015.

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3. Description of the Pendant

The pendant was found within context 317, a brown-green fine detrital mud containing a high proportion of organic material within the matrix. The contexts are currently being dated and modelled using Bayesian statistics by Alex Bayliss (Historic England) but at present it is possible to say that these sediments formed at around 9000 cal BC. The pendant was deposited into shallow water, at least half a metre deep and approximately 10m from the lake shore. Reeds, sedges and a suite of aquatic plants were all growing in the immediate area, forming a species-rich swamp environment.

The pendant is sub-triangular in shape, measuring about 31mm by 35mm and 3mm thick (Figure 4). ED-XRF (energy-dispersive x-ray fluorescence) analysis was carried out to confirm whether it was made of shale (Rowley and Needham [2015](#)). Element concentrations were measured using an Olympus Delta Portable ED-XRF Analyzer. The elemental composition data was compared with that published in Rowe *et al.* ([2012](#)) and can be demonstrated to be consistent with the composition of shale.

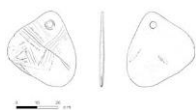


Figure 4: Illustration of the pendant (by Chloe Watson)

Unfortunately, the artefact sustained damage from trowelling towards the base of the engraved surface. These marks appear as light scratches and are easy to differentiate from the fine engraved lines. The stone is fragile

with the potential to laminate, hence much care has been taken when handling it, and powder free nitrile gloves were worn to avoid contamination in advance of residue analysis.

There is a perforation in one of the vertices that has been made by drilling through from the engraved side of the pendant. The engravings appear on one side only and the lines are very faint: the smallest lines are hard to distinguish from one another with the naked eye. The artwork uses the incision method which is the most common and least specialised of Early Mesolithic artwork, the other types being pricking and drilling to create dots (Clark [1936](#)). Most of the lines can be classified as linear and in Clark's terminology barbed lines of 'type C', i.e. lines that come off another line at right angles (Clark [1936](#), 169).

On the reverse side to the engraving there is a nick caused by a missing flake of shale in the central region, shown clearly from the scan of the artefact (Figure 5). This may have happened accidentally or intentionally, presumably by something hard striking this surface before it was deposited in the lake.



Figure 5: 3D scan of the pendant that clearly shows the missing flake on the unengraved side of the pendant. [View](#) (3D viewer. Opens new window) | [Download](#) (.PLY) | [3D Print](#) (.STL). (CC BY licence still applies)

This artefact is being termed a 'pendant' because the perforation is not central, implying that it may have been suspended and worn as a necklace. The other perforated shale objects at the site were defined as 'beads' by Clark since the perforations are more or less central, the only exception being the 'celtiform bead' (Clark [1954](#), 165) which could in fact also be classified as a pendant (Figure 6). It is unclear how the shale beads from Star Carr were worn: whether they were items of jewellery or perhaps appliqués (Cristiani *et al.* [2014a](#); Langley and O'Connor [2015](#)). Further use-wear analysis on these other beads is planned, and will aim to address this question. Of the three pieces of amber found, one was classified as a pendant; this piece has two holes at the top (Figure 7) (images of most of the finds from the original excavations by Clark can be found in the Archaeology Data Service [Star Carr Archives Project](#): (Clark [1954](#); Milner *et al.* [2013a](#)).



Figure 6: The shale beads from Star Carr and the 'celtiform bead' at the top (Museum of Archaeology and Anthropology, Cambridge, accession number: 1953.72.



Used with permission)

Figure 7: The perforated amber pendant (Museum of Archaeology and Anthropology, Cambridge, accession number: 1953.70. Used with permission)

In the 2015 excavation, two further shale beads were discovered that are typical of the majority of beads found by Clark. What is noteworthy is that these beads were not found in the same context as most of the other archaeological material that Clark excavated. Instead they were recovered from the wood peat that dates to approximately 100 years later than the phase to which the engraved pendant and the headdresses belong. Although Clark ([1954](#), 19) plotted the spatial distribution of many of the artefacts from his excavations in his monograph (see Figure 8), the depths were not recorded and the archive appears to have been destroyed (Milner *et al.* [2013a](#)). From our current understanding of the stratigraphy and typology of the artefacts, it is likely that the small shale beads are later in date than the engraved shale pendant. It is always possible that the amber pendant and celtiform shale pendant were contemporary with the engraved pendant; however, as there is no contextual information for those finds, this hypothesis will remain unresolved.

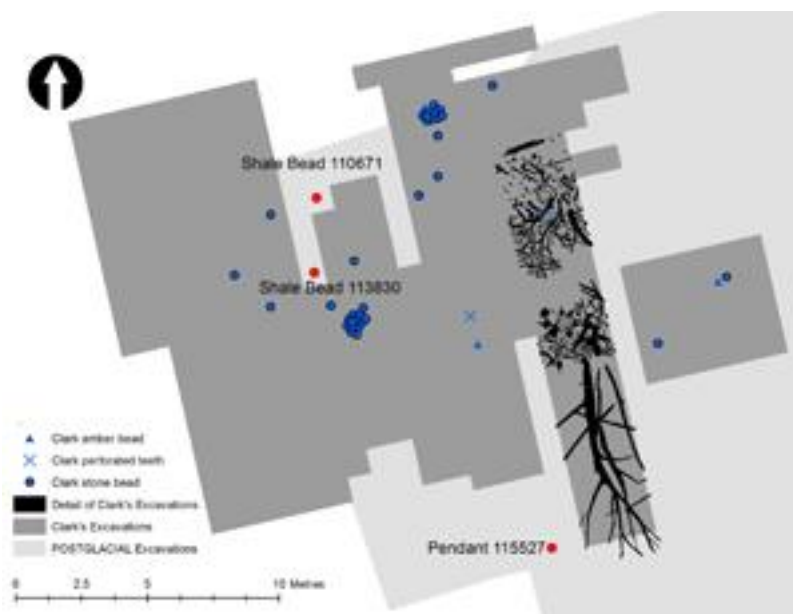


Figure 8: Location of the find in relation to Clark's artefacts. The two shale beads, marked in red on

the plan, were also found in 2015 within a later context than the majority of Clark's other finds and the engraved shale pendant

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4. Analysing the Engravings

4.1 Methods

A number of imaging methods have been employed to assess the direction of the lines, to understand their relationship to each other, and the line order and phasing. To do this we integrated light microscopy, reflectance transformation imaging (RTI), white light 3D surface scanning, and scanning electron microscopy (SEM).

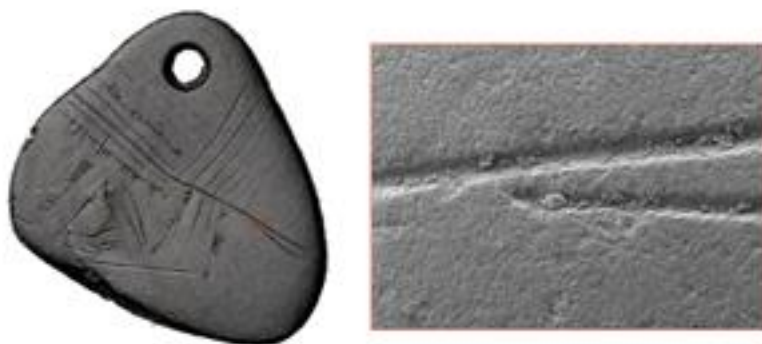


Figure 9: An example of an image taken with SEM demonstrating that two lines do not meet. It is also possible to assess the direction that the incision was made, with working from left to right in this instance. Image captured at 50x magnification using secondary electron mode

Light microscopy was used but was limited to low power light microscopy, using a stereoscope with 10x to 100x magnification. The shallowness of the engravings presented a challenge for assessing the line order, further compounded by the presence of highly reflective gold-coloured iron pyrite crystals adhering to the surface (see below), which made analysis with conventional light microscopy challenging; the fixed and direct light source making the engravings virtually invisible. This is a common

problem when analysing shallow engraving on stone surfaces, thus digital methods are increasingly advocated as alternatives to or as methods to be used in tandem with microscopy (Bello *et al.* [2013](#); Fritz [1999](#); Fritz and Tosello [2007](#); Güth [2012](#); Tosello and Villaverde [2014](#)).

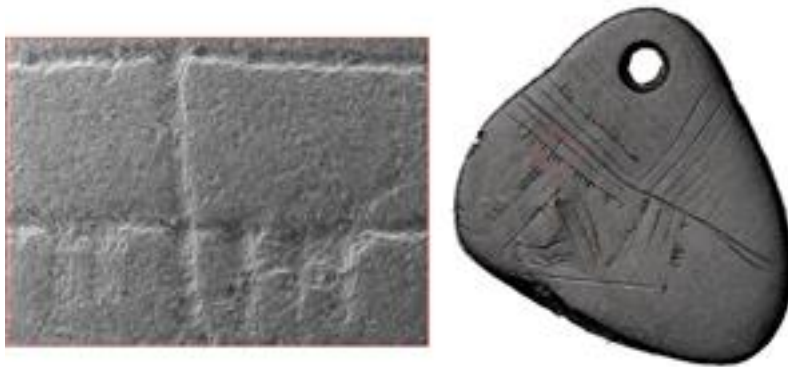


Figure 10: SEM image showing the precision of the short lines that have been incised at right angles from a longer line. Image captured at 50x magnification using secondary electron mode

In contrast, SEM, a non-light based technique, yielded significantly better results on this surface. The reflection from the gold-coloured particles was immediately removed by the SEM, making line-order relationships far easier to recognise and analyse. A Hitachi TM3030Plus tabletop scanning electron microscope (SEM) was used to image key details of the engraved lines (Figures 9, 10 and 11). This piece of equipment was chosen over other SEM options since it is non-destructive to artefacts. No sputter-coatings (such as gold, carbon, palladium) are required for imaging using this SEM; a major advantage to traditional high vacuum SEM analysis. SEM images were collected in secondary electron mode and backscattered electron mode and from 25x to 3000x magnification.



Figure 11: SEM image showing the order of engraving. The central groove is earlier, with the diagonal grooves engraved later. Each groove was drawn from the central groove, running away from it. Image captured at 40x magnification using secondary electron mode

Similarly, the composite images produced using RTI, and manipulating the light source to an oblique position within the software, provided a highly effective tool for assessing the relationships between engraved lines. RTI is a form of computational photography. A set of photographs of an object are captured from a fixed camera and in each photograph the object is lit from a different direction. Using software called RTI builder, these photographs are then combined in order to generate an interactive image within which the user can control the direction and power of the light. RTI works by calculating the surface of an object based upon the appearance of each pixel when lit from multiple light positions. Each pixel is assigned a direction and an angle of slope based upon its appearance within the original photographic dataset. Using the resulting surface model it is possible to apply visualisation algorithms to enhance surface characteristics (Malzbender *et al.* [2004](#)).

Figure 12: RTI viewer. Examine the pendant using the WebRTIViewer. Use the ? button for help in using the viewer.

RTI has the capacity to reveal complex surface details such as small incisions or wear marks (Riris and Corteletti [2015](#)) and has been used

extensively in the detailed examination of archaeological material (Earl *et al.* [2011](#); Jones *et al.* [2015](#); Newman [2015](#)), including finds from Star Carr (Duffy [2013](#)). In this instance, the method has helped to enhance the incised surface details on the pendant and the sequence of incisions is made much clearer through the enhancement of specific details at the intersection of lines (Figure 12). RTI has also been useful in helping to develop an overall impression of the patterning through the production of images using specular enhancement (Figure 13). Specular enhancement allows the user to alter the appearance of the captured object by suppressing the colour of the surface and making it more reflective. Using this technique it becomes possible to observe underlying topological characteristics without colour information. This was very useful in observing incisions on the surface of the shale pendant that were unclear from the original photographs.

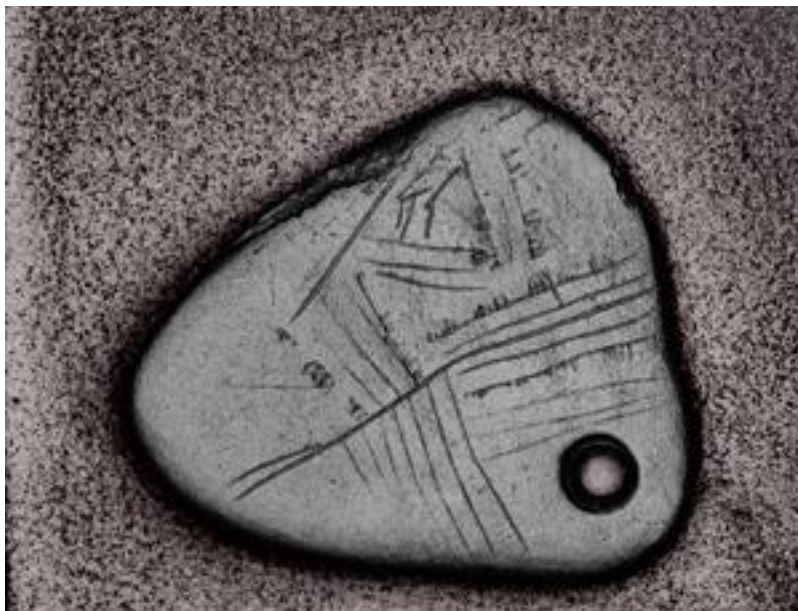


Figure 13: An image of the pendant using specular enhancement

The light-based microscope was used to support a line-order analysis primarily established through these digital methods, being used to cross-

check results against the pendant's unmodified surface. The use of these varying methods in tandem yielded a better understanding of what is a very fine and subtle series of engraved lines, in parts heavily modified by post-depositional action, than any single method in isolation might have allowed.

In addition, we attempted to surface scan the object in order to create a detailed 3D record, particularly in light of the fact it is very fragile and prone to lamination. White light 3D surface scanning was carried out using a Breuckmann SmartScan 3D-HE (Breuckmann GmbH, Meersburg, Torenstraße). Both sides were scanned individually and superimposed, using common landmarks found on the edges of both scans, using the image-processing software Avizo 8.0 (Visualization Science Group Inc). The mesh was then cleaned using MeshLab v1.3.2 (Visual Computing Lab –ISTI-CNR). This produced a 3D model of the pendant, which while removing the original colour, was able to highlight surface details including some of the faint engraving and the nick on the non-engraved side (see [Figure 5](#)).

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4.2 Results

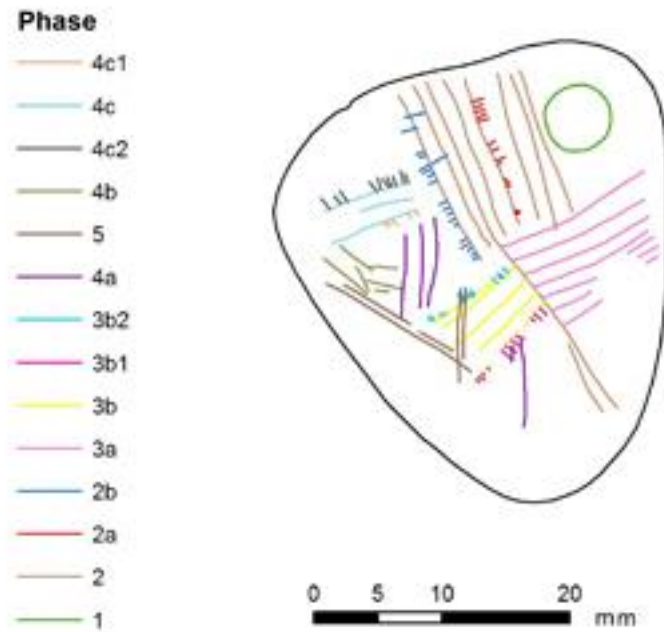
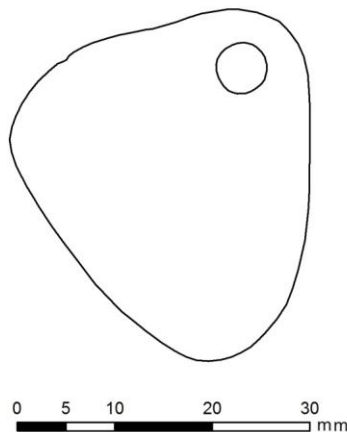


Figure 14: A composite image of phasing, as set out in the slideshow. For ease of orientation in the following discussion, the pendant has been divided into coordinates: north being the top

Through the analysis of the pendant using the techniques outlined above, it was possible to gain a sense of the ordering of the lines and the potential phases of the engravings. These are presented in a composite image, Figure 14, and as a slide show with a narrative and rationale (Figure 15).

Figure 15: Phases of working (slideshow)





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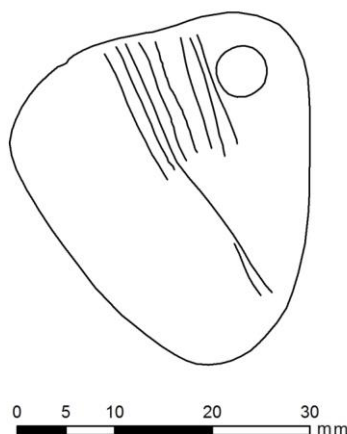
Phase 1: the perforation

The uniconical shape of the perforation suggests working from a single direction, with the engraved surface being the working face. Our experiments have shown that perforating shale poses the risk of breakage, especially when positioned close to the edge as in this case; thus it is probable the piece was perforated and then subsequently engraved. There is no overlap between the perforation and engraving to test this directly. However, the engraving does seem to respect the position of the perforation, and as the drilling action involved in perforating the object could potentially break it there would be a higher risk of damaging the engraving if the object was perforated after it had been engraved.

The visible traces of working within the perforation suggests it was produced with a rotational, drilling action. This is likely to have been carried out using a narrow-profile, pointed, retouched tool, such as a

microlith or bladelet. Experimental replication confirmed this interpretation, with pieces that were perforated uniconically, with relatively light pressure, and with the tool held rather than hafted, closely resembling the pendant. The neater, smaller hole on the non-engraved side of the pendant (clearly shown in the laser scan, see [Figure 5](#)) further supports an interpretation of uniconical working.

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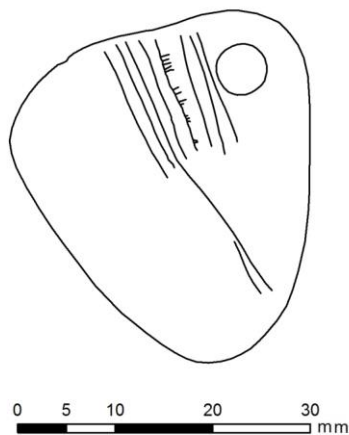
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Phase 2: engravings

There is a series of nine grooves running directly next to the perforation in the direction of the long axis of the pendant, henceforth referred to as phase 2. These grooves have been grouped on the basis of their similarity in profile shape and line orientation, likely indicating the use of the same engraving tool during the same phase of working. As they do not directly

interact, the specific order of engraving cannot be ascertained. With a nominal 'north' to the top of the illustrated pendant, the working of this series is likely from 'north-west' to 'south-east'. A longer central groove, stretching across the length of the pendant, is of key significance in phasing the engraving. This groove is deeper and has a shorter groove associated with it to the far 'south-eastern' extent of the pendant.

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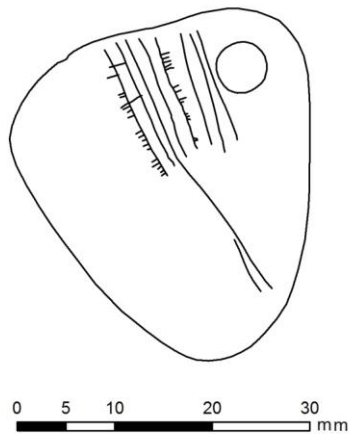


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Phase 2a

The groove fourth from the perforation has additional grooves drawn from it, 14 in total, henceforth referred to as phase 2a, and can be described as a barbed line of type C (Clark [1936](#), 169).

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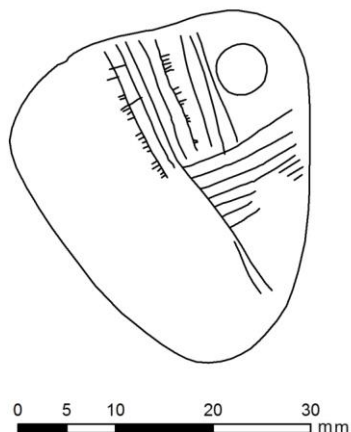


Phase 2b

The eighth groove from the perforation in this arrangement has a number of branching grooves that stem from it, 18 in total, henceforth referred to as phase 2b, also a barbed line. The nine grooves constituting phase 2 were engraved before phases 2a and 2b. All of the grooves forming 2a and 2b disrupt and cut the grooves of phase 2 where they make contact. It should be noted, 2a and 2b are arbitrary labels and do not reflect the order of phasing. These grooves might conceivably have been added at any later phase, or potentially in smaller groups in multiple phases. As they only cut the grooves of phase 2, and do not interact with grooves from any other phase, it is impossible to discern a specific relationship beyond this, though the most likely hypothesis is that they are temporally associated and together form barbed line motifs. It seems likely, given their uniformity in shape and orientation, that they were engraved at the

same time and relatively rapidly after phase 2, probably using the same engraving tool. The grooves of 2a were engraved from 'south-west' to 'north-east', while the grooves of 2b were engraved from 'north-east' to 'south-west'. That is, all grooves of these sub-phases were drawn from the point of contact with an existing groove in phase 2, running perpendicular and away from this point of contact.

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Phase 3: engravings

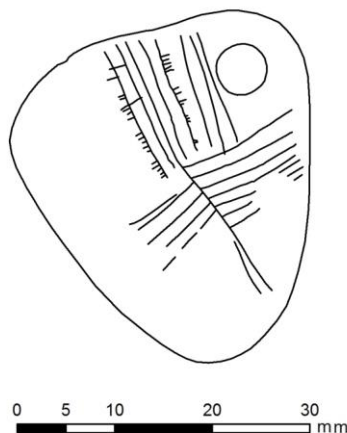
Phase 3 consists of two major groups of grooves; group 3a consisting of seven grooves to the 'north-east' of the central groove and group 3b consisting of five grooves to the 'south-west' of the central groove. Each has been grouped as a sub-phase on the grounds of similarity in profile shape, similarities in the incisions that suggest the same or similar tool

was used to produce the grooves, as well as orientation.

Phase 3a

The grooves composing sub-phase 3a are younger than phase 2, with each groove cutting the profile of the central groove. The direction of working for grooves composing 3a is 'south-west' to 'north-east'. The four grooves to the far 'south-eastern' extent of 3a each have the mid-section of the groove partially or entirely obliterated. Initially thought to have resulted from wear, results from use-wear analysis (discussed in [section 5](#)) suggest this may have been caused by post-depositional factors (PDSM). The groove to the far 'north-western' extent is significant in that it disrupts the terminus of the northern grooves in phase 2, confirming that sub-phase 3a, and by extension perhaps all of phase 3, is younger than phase 2.

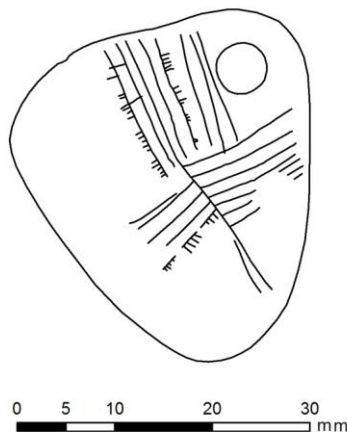
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Phase 3b

Sub-phase 3b consists of five grooves, each disrupting and cutting the central groove at the point of contact, indicating they are younger than phase 2. The direction of working for grooves constituting 3b is 'north-east' to 'south-west'. As identified in previous phases, grooves constituting 3a and 3b are engraved from a point of contact with an earlier groove and are engraved in a perpendicular orientation, running away from the point of contact. Grooves to the 'southern' extent of 3b at the groove mid-point and further 'west' have again been partly obliterated, as was noted for grooves to the south-eastern extent of 3a.

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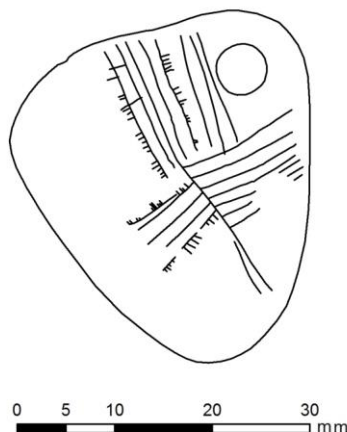
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Phase 3b1

Similar to the pattern identified in phase 2, barbed line groupings of

small, perpendicular lines stemming from longer grooves appear. Sub-phase 3b has two further such groupings, sub-phase 3b1, composed of 11 short grooves contacting the far 'southern' groove of sub-phase 3b, and sub-phase 3b2, composed of 14 short grooves contacting the far northern groove of sub-phase 3b. These have been grouped into sub-phases on the grounds of similarity in profile shape, suggesting the same tool might have been used, as detailed above for other phases.

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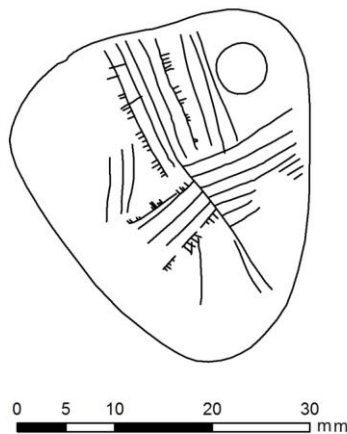
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Phase 3b2

Sub-phases 3b1 and 3b2 conform to the pattern described more broadly, with each groove cutting through the profile of grooves belonging to sub-phase 3b, indicating that all short grooves belonging to sub-phases 3b1 and 3b2 are younger than grooves belonging to sub-phase 3b. Short

grooves associated with sub-phase 3b1 have been engraved from 'north-west' to 'south-east', while short grooves forming sub-phase 3b2 have been engraved from 'south-east' to 'north-west'. This pattern again conforms to that seen for earlier phases where the direction of working runs away from contact at a perpendicular angle to the earlier groove.

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Phase 4: engravings

The groupings of phase 4 are more contentious, in part due to a lack of direct contact between phases previously described and an arrangement of grooves that do not conform to the same pattern, with fewer interconnections between grooves. Three sub-phases and two additional sub-phases linked to one of these sub-phases are evident, but the phasing of the piece here becomes ambiguous. It could be that phase 4

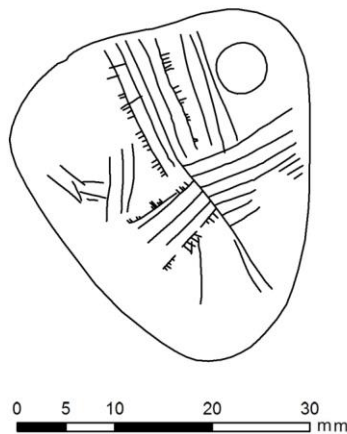
follows phase 3, occupying one of the few vacant areas left on the surface, or it could be the exact opposite, actually representing the earliest phase, with those phases already described engraved at a later time. These possibilities are explored in greater detail in the phasing summary below.

Phase 4a

Sub-phase 4a consists of three grooves engraved from 'north' to 'south'. These grooves have been grouped based on direction of working, orientation and the similarity in profile shape. The far 'western' groove in this sub-phase looks to be cut by grooves associated with sub-phase 4b, described in greater detail later on, suggesting 4a may be an older component of phase 4. Significantly, an otherwise anomalous set of two possible grooves may be associated with phase 4a, based on their orientation. However, the spatial dislocation of these grooves, as well as the dissimilarity in profile size and shape makes such an association highly tentative. If they are associated, this would be highly significant as it would potentially offer a way to directly link and order phases 3 and 4. However, the relationship between these grooves and sub-phase 3b1 could not be discerned.

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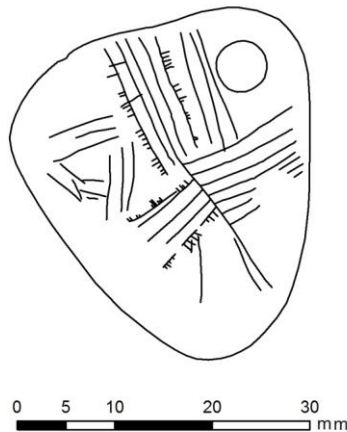




Phase 4b

Sub-phase 4b is more complex and dissimilar to most other groupings in that it is formed of grooves seemingly worked in two differing orientations. It is composed of six grooves, broadly set out in two groups of three. These grooves have been grouped largely on the grounds of their close spatial relationship and their dissimilarity to the otherwise structured pattering evident in other phases. Those grooves from the 'eastern' component of the grouping have tentatively been worked from 'east' to 'west' and disrupt the far 'western' groove from sub-phase 4a, as discussed earlier. This would suggest sub-phase 4b is younger than sub-phase 4a. The grooves forming the western component of sub-phase 4b can be tentatively interpreted as having been engraved from 'north-west' to 'south-east'. The specific interaction of these grooves at contact is ambiguous, though it can be noted that an anomalous 'north'/'south' orientated groove interacts with grooves from both sub-groups.

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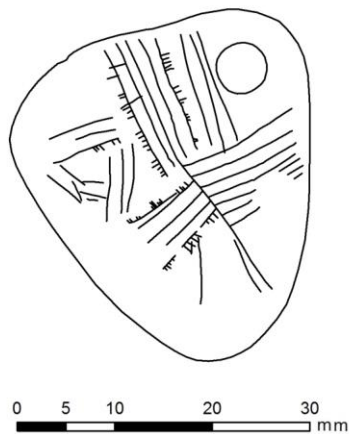
Phase 4c

Sub-phase 4c consists of three grooves that have been grouped on the basis of orientation, profile shape and direction of working. They do not interact with any other groupings and so are challenging to interpret.

However, sub-phase 4c is associated with two further sub-phases, 4c1 and 4c2, which when taken together bear a striking resemblance to barbed line groupings described in phases 2 and 3 above. The grooves forming 4c have been engraved from 'east' to 'west'.

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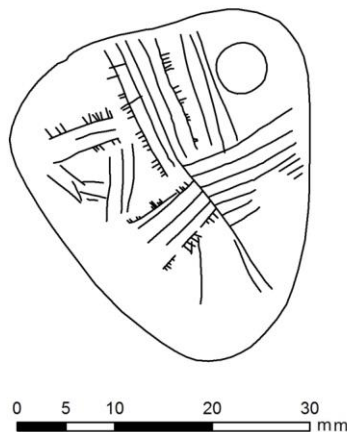
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Phase 4c1

Sub-phase 4c1 is associated with the far southern groove of sub-phase 4c, and consists of five short grooves. They have been grouped based on their profile shape, orientation and direction of working. These follow the familiar pattern described above of having been worked at a perpendicular angle, each cutting the groove of 4c with which they interact, demonstrating they are younger. These grooves have been worked from 'north' to 'south'. Sub-phase 4c1 is younger than sub-phase 4c.

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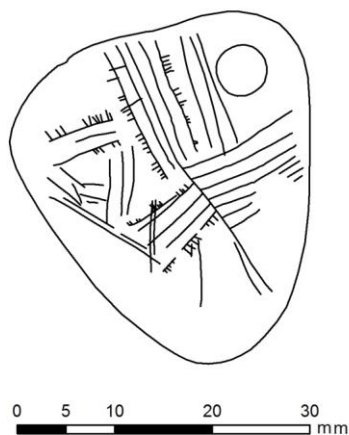
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Phase 4c2

Sub-phase 4c2 is associated with the far northern groove of sub-phase 4c. It is composed of 10 short grooves that have been phased together based on their profile shape, orientation and direction of working. The grooves have been engraved from 'south' to 'north' in all cases. Sub-phase 4c2 parallels sub-phase 4c1 in that the grooves have been worked at a perpendicular angle to the groove with which they interact from sub-phase 4c, running away from the point of contact. In each case, the grooves of 4c2 disrupt the groove from 4c, demonstrating that the grooves belonging to sub-phase 4c2 are younger than sub-phase 4c. The close similarity between this pattern of sub-phases when compared to similar groupings described in phases 2 and 3 may suggest a relationship; the pendant may have been engraved in a single event, the phases perhaps reflecting momentary pauses and adjustments as the object was

repositioned rather than longer temporal dislocations between phases of working.

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Phase 5: modern damage

Phase 5 is composed exclusively of modern excavation damage caused by contact with a trowel, with at least two strikes causing some marking and with some possible evidence for a scraping motion.

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4.3 Summary of phasing

Analysis of line order reveals two major phases of lines, as expressed in Figure 16. The majority of lines conform to a pattern of intersecting earlier phases of engraving at a perpendicular angle. Some of these arrangements conform to Clark's ([1936](#), 169) barbed line type C designs. A repeating element emerges in this arrangement, with longer lines later intersected by smaller lines. This is most evident with the smaller, tightly packed groups of lines, expressed as sub-phases above. These barbed line groups always feature at the outermost lines of a series of longer lines and repeat across multiple orientations. This very specific pattern suggests they might have been produced contemporaneously. On the grounds of orientation, an additional phase emerges, which does not entirely conform to this pattern. Lines are grouped, parallel and of a similar length, though markedly less so, with a significant spatial dislocation in those lines running 'north'/'south'.



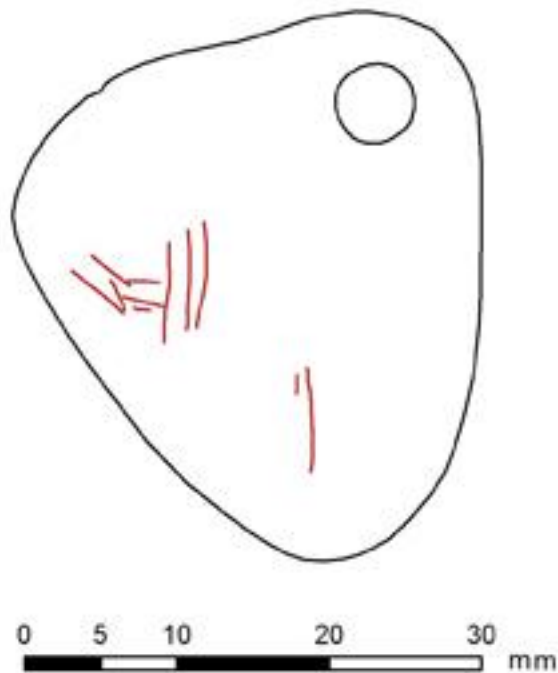


Figure 16: The two main types of lines

The chronology of these differing working styles is difficult to discern. There is no unambiguous point of connection between phases 3 and 4. It could be the case that the more erratic pattern is the earliest engraving. The later engraving of the more heavily ordered phases might have cut over the top of a pre-existing design, of which this is the remnant. This model necessitates heavy wear to the surface, obliterating much of the earlier design through a combination of wear and re-engraving. Given the soft raw material, this is a feasible interpretation. However, the more likely model would instead place the erratic engraving as a later phase

that filled areas of empty space. It is interesting to note that those lines which feature small, grouped lines are never subsequently cut by longer lines. If this observation holds true, there was no further room for any long linear lines running 'west-east'/'east-west' to the southern half of the pendant given the placement of the existing arrangements running 'north'/'south'. Instead, the orientation has been changed and further long linears used to fill the gaps. In this model these 'erratic' lines do fit the broader pattern of working but reflect the increasing lack of space and difficulty in properly repeating the pattern of working. This must remain a speculative hypothesis given the lack of a direct discernible relationship between phases 3 and 4.

The presence of a repeating barbed line pattern (Clark [1936](#)) across multiple phases of the engraving is significant in potentially supporting a model of the rapidly laying down of lines across the surface of the pendant. It is less likely that such a specific design pattern was used in multiple phases of working over long time scales and maintained a rigid sameness to earlier phases: if later phases emulated earlier phases, one might still see some variance through, for example, inaccurate copying.

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5. Use-wear and Residue Analysis

5.1 Use-wear analysis

Recent microwear research carried out on Mesolithic ornaments, mostly from burial contexts, has shown that this method can reveal significant information regarding an ornament's manufacture and function (Cristiani *et al.* [2014a](#); [2014b](#); Larsson [2006](#); Rigaud *et al.* [2015](#)). With this in mind microwear analysis was carried out on the pendant. Using a low power stereoscope at magnifications x10-x100, followed by high power analysis with a Leica DM1750M reflected light microscope at magnifications ranging from x10-x50, with eyepiece magnifications at x16, the entire surface of the pendant was analysed for wear traces.

Analysis was made difficult by the amount of highly reflective inclusions of what appeared to be iron pyrite (see [residue section](#)) and post-depositional surface modification (PDSM) which has resulted in the entire surface displaying a sheen or 'brightness'. This brightness is caused by two factors: reflective pyrite inclusions and a general abrasion to the surface caused by the soft shale pendant sitting in mud and water for 11,000 years.

The slightly more worn areas of the engraving mentioned in [section 4.2](#) phase 3 (Figure 17) display no wear polish that can be attributed to anthropogenic activity; microscopically, there is no distinction on the surface of the pendant at these locations from any other part of the

surface. One explanation is that they may, due to their higher topography, have become more affected and worn through time due to natural processes.

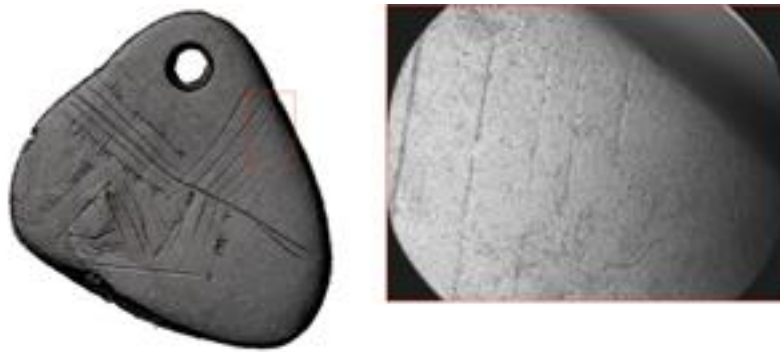


Figure 17: SEM showing areas of engraving that have been obliterated, probably from natural processes. Captured at 25x magnification using secondary electron mode

No discernible evidence for wear traces relating to suspension could be found from within or around the perforation. However, it remains possible that the pendant was suspended and worn, but for such a limited duration of time as to leave no traces. Indeed, it is also possible that it was intended for a single use, such as a ceremony, which is unlikely to leave any signatures of use at all. The adjacent edge of the nearest vertex did, however, display a slightly brighter sheen compared to the other edges. This is also the location where polish emanating from wear would be expected if the pendant was suspended with the perforation at the top and the long axis of the triangle at the bottom. This may indicate that it was in fact suspended and worn as a pendant but as this location is just a slightly brighter area and cannot be characterised as polish *per se* (Vaughan [1985](#)), and displays no clear directionality, striations or rounding, and given that the entire surface of the pendant has a sheen, such an interpretation comes with a strong caveat.

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5.2 Residue analysis

5.2.1 Aims

The pendant was investigated for any trace microscopic residues that might indicate how it had been made and used, with a particular focus on whether coloured materials, such as ochre, charcoal, or resin had been used to emphasise the lines. Four residues were identified: brown staining, gold-coloured crystals, biological structures, and white crystals. In addition, two soil samples from the same context as the pendant were tested as controls for contamination from the surrounding burial environment.

5.2.2 Methods

The pendant was first analysed using reflected light microscopy (Leica DM1750 M), using objectives ranging from 5x to 100x, and an eyepiece magnification of 16x. Each engraved line on the pendant was systematically examined and the locations of microscopic residues were mapped. A series of z-stacked micrographs were taken for each microscopic residue to make a composite image, using Leica Montage software. Soil sample controls were prepared by direct mounting on glass slides with double-sided tape and examined with reflected light microscopy. Secondly, located residues were investigated with a variable pressure SEM (Hitachi TM3030Plus), as outlined in [section 4.1](#).

Residues were further analysed with microscopic confocal Raman spectroscopy (Micro-Raman). Micro-Raman is a spectroscopic technique utilised for the identification of crystal and molecular structures employing lasers to excite vibrational and stretching modes within the samples; this technique can suggest the chemical nature of microscopic residues with a high degree of specificity. Micro-Raman is minimally destructive to the residue in that an area of the residue of interest, about 20 μm^2 , is burned by the incident laser beam during analysis. A HORIBA Jobin Yvon Xplora confocal Raman microscope with LabSpec 6 and IGOR Pro software for peak analysis were used to collect and evaluate spectra (Physics Department, University of York).

Four areas of the pendant were investigated with Micro-Raman: brown deposits within the engraved lines, gold-coloured structures (suspected to be pyrite), biological structures, and white crystals within the perforation hole. The 100x objective was used to record images of the exact locations of laser penetration on each residue. Many spectra of suspected pyrite crystals on the pendant were collected; however, fluorescence of the material and scattering due to the microtopography of the sample often resulted in spectra that had poor signal to noise ratios. Thus, several spectra were discarded because they were too 'noisy' to discern any peaks.

5.2.3 Results: brown stains

The depressed area within the engraved lines contained brown deposits (Figure 18). Micro-Raman analysis was conducted to identify the possible presence of crystalline phases in these areas that could be associated with

the presence of pigments. However, the respective spectra showed no evidence for this. Rather, spectra collected from the brown deposit within the lines shows that the brown material is organic in nature (Figure 19) and it is very likely that this is peat from the burial environment that has become entrapped within the grooves.

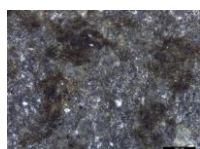
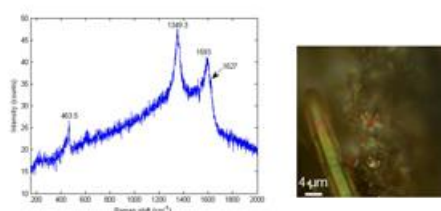


Figure 18: The engraved lines on the pendant can be seen microscopically as depressed grooves with brown infilling. (Light



Microscopy)

Figure 19: Micro-Raman spectra taken of brown deposit from within engraved line 11. Clear presence of organic material is indicated, likely peat

5.2.4 Results: gold structures

A large number of gold structures were seen on the pendant during inspection with light microscopy. These structures were located on the surface of the stone, in the engraved lines, in the perforated hole, and also within a nick on the back of the pendant. Two types of gold structures were found: equilateral triangles (max. diameter approximately 5.6 μm), and granular spherical crystals (max. diameter approximately 40 μm), which were located on the non-engraved side of the pendant within the nick mark (Figures 20 and 21).

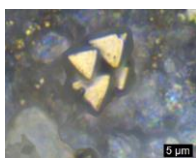


Figure 20: Gold structures with triangular faces. (Light

Microscopy)

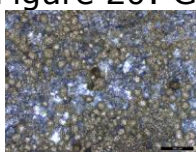


Figure 21: High density of granular spherical crystals located within the nick mark on the non-engraved side of the pendant. (Light Microscopy)

It was noted that pyrite had previously been found at Star Carr, possibly used as firelighters (Clark [1954](#), 20) though none have been found within the museum archives (Milner *et al.* [2013a](#)) for comparison. One hypothesis on discovering the pyrite on the shale pendant was that it might have been struck with iron pyrite. A reference piece from the nearby coast was pounded on a hard surface and the resulting residue mounted on a slide for observation. It was clearly shown that this produced angular pieces as opposed to the forms found on the pendant (Figure 22).

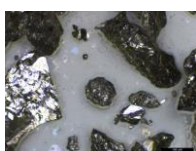


Figure 22: Gold angular pyrite from the reference collection. (Light Microscopy)

The framboidal structures seen under the light microscope were confirmed under SEM as overall spheroid shapes with individual cubo-octahedral microcrystals (Figure 23) (cf. Butler and Rickard [2000](#); Popa *et al.* [2004](#)), typical of pyrite. The Raman data obtained support the suggestion that the crystal structures with triangular faces and the framboids were pyrite. Figure 24 shows an example of the spectra obtained from these samples.

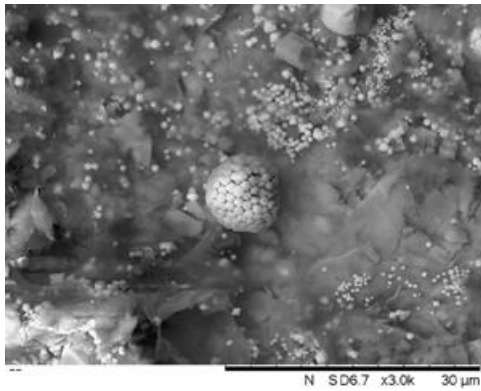


Figure 23: Close up of a pyrite framboid with cubo-octahedral microcrystals. SEM, backscattered electron mode

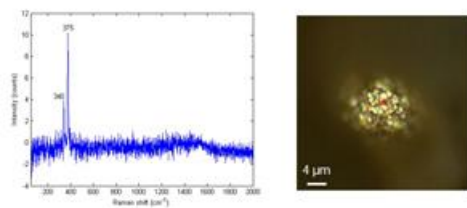


Figure 24: Micro-Raman spectrum collected from the red spot on the framboidal structure

Anisotropic pyrite contains two intense peaks at $\sim 342\text{cm}^{-1}$ and 377cm^{-1} , and one minor peak at 428cm^{-1} (Mernagh and Trudu [1993](#), 118). The ENS de Lyon Handbook of Minerals Raman Spectra (Anon. [2000](#)) quotes three Raman frequencies in anisotropic pyrite: two strong peaks at $340\text{--}342$ and $375\text{--}377$, as well as a minor peak at 428cm^{-1} (Anon. [2000](#)). According to Demoisson *et al.* ([2008](#), 345), pure pyrite shows scattering signals at 340 and 377cm^{-1} . Both Raman spectra from the triangular crystals and framboids are consistent with reference spectra for anisotropic pyrite. As can be seen in the spectrum figure X, the first two prominent bands are clearly present. The third low-intensity peak at 428cm^{-1} noted by Mernagh and Trudu ([1993](#)) and in the Handbook of Minerals (Anon. [2000](#)) is not completely clear. The third peak may be present, but it is difficult to resolve due to signal-to-noise distortion in the spectrum.

It is concluded that the gold-coloured crystals found on the pendant are natural pyrite, not an anthropogenic addition of pigment to the pendant. Pyrite is known to form naturally by the decomposition of organic material in peat bogs (López-Buendía *et al.* [2007](#)). Triangular and framboid pyrite crystal formations were also observed within two soil samples taken from the context in which the pendant was found.

5.2.5 Results: biological structures

Several unidentified fragments of what appear to be lacustrine zooplanktonic microfauna such as fairy shrimp, copepods, cladocerans, ostracods, or insects, were identified within the engraved lines of the pendant. One of these fragments, mapped to location 1 within line 1 on the pendant surface (Figures 25 and 26) is probably the remains of a copepod, a very small crustacean. No microfauna were found within the soil samples analysed, although specimens may have been bound up in soil aggregates and thus obscured.



Figure 25: Fragmentary microfaunal remains, likely part of a copepod. Location 1, line 1. (Light Microscopy)



Figure 26: Fragmentary microfaunal remains, likely part of a copepod. Location 1, line 1. SEM, secondary electron mode

There was some question as to whether the putative biological structures were perhaps mineral in origin. Thus, one of these structures (at location 9 on the pendant, see Figure 27) was investigated with Micro-Raman in three locations. The presence of carbon in three spectra confirmed it was organic (Figure 28).

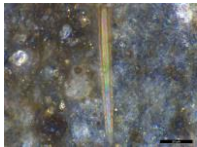
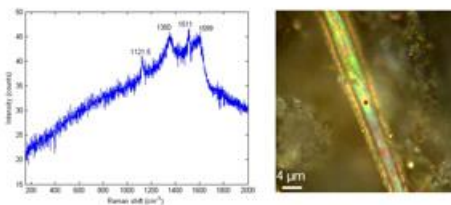


Figure 27: Location 9. Biological structure, possibly a diatom. Micro-Raman analysis has showed the structure is carbon-rich, and thus likely organic. Location 9, line 11. (Light Microscopy)



Raman spectrum collected on suspected microfaunal remains in one of three locations demonstrating that this is organic Figure 28:

The conclusion from the Micro-Raman analysis is that these are biological structures but a number of specialists have been unable to make a specific identification. They are not related to the use or manufacture of the artefact and might have adhered within the engravings owing to the pendant being placed within the lake edge deposits where such microfauna naturally occur.

5.2.6 Results: white crystals within the perforation

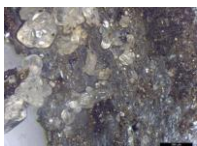


Figure 29: Rounded quartz crystals within the perforation of the pendant. (Light Microscopy)

Clear and white translucent globular crystals were located within the perforation of the pendant. These crystals were not angular, but show

what appears to be weathering as their edges are rounded (Figures 29 and 30).

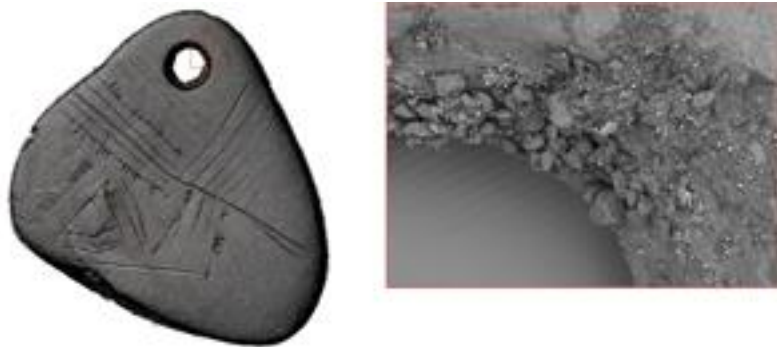


Figure 30: SEM image of the perforation and crystals within it. Image captured at 200x magnification

These crystals were investigated with Micro-Raman. Good-quality spectra with minimal noise and fluorescence were able to be obtained on the smooth surface of one of these crystals (Figure 31). According to Kingma and Hemley ([1994](#), 270), the most prominent Raman band in quartz (SiO_2) is located at 465cm^{-1} , which is detected in our spectrum at around 464cm^{-1} . The Handbook of Mineral Raman Spectra (Anon. [2000](#)), quotes 464cm^{-1} as the most intense frequency of powdered quartz, matching the major peak we obtained. Less intense bands related to the Raman assignment of quartz were also detected in our spectrum as indicated.

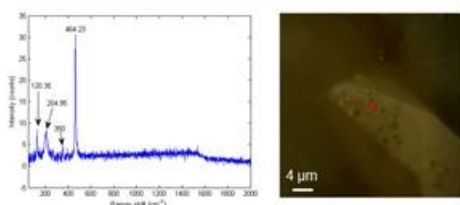


Figure 31: Micro-Raman spectrum collected from a crystal grain located within the perforation of the pendant

In conclusion, the Raman spectrum matches closely with reference spectra for quartz. Clear crystals that were hexagonal in two dimensional outline were also noted in one of the soil samples, although no suggestion

can be made as to their chemical nature. No quartz crystals similar in appearance to those found within the hole of the pendant were able to be located in the soil samples. However, it should be noted that only two soil samples from the context were analysed. Also, no soil samples that were in direct contact with the pendant were taken at the time of excavation, and thus it is possible that this surrounding area may have contained the same quartz sand as found within the hole.

The reason for the quartz in the perforation is not clear. One possibility is that the sand had been used in the manufacture of the hole; however, experiments over the last year on shale have shown that because shale is a soft stone it is very easy to create a hole with a flint tool, such as a stone drill (*mèche de forêt*), and therefore sand would not be necessary.

The origin of this sand remains an enigma: quartz crystals were not found anywhere else on the pendant nor within the soil samples analysed.

However, sand is present on the site, and in some cases within areas of the peat because it has washed down from the dry land. Therefore, it may be that fine sand has settled within the hole as part of the deposition process, perhaps even because the lake water has filtered through this hole.

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6. The Pendant in Context

6.1 Overview of engraved portable art in southern Scandinavia

Overall, engravings on Mesolithic pendants are extremely rare, with the exception of amber pendants found in southern Scandinavia (Płonka [2003](#)). Art has also been found on a number of other types of portable artefacts made from a range of materials including bone, flint, antler and wood, and the centre for this art can be argued to be Denmark owing to the sheer quantity of examples that have been found there; other pieces have also been found in Sweden, Germany, Poland, Russia, Estonia, France, Belgium, Spain and Britain (Płonka [2003](#)). It is unclear exactly how many pieces exist, but Nash ([1998](#), 2) suggested that at least 400 antler and bone artefacts with art inscribed on them originate from Denmark.



Figure 32: The antler piece from Bodal Mose, Åmose (Photograph by Arnold Mikkelsen, Nationalmuseet, CC BY-SA <http://samlinger.natmus.dk/DO/9617>)

A stray find in 1950 from Bodal Mose, in the Åmose on the island of Zealand, Denmark, is an example of an elaborately decorated piece of antler (Andersen [2001](#); Brinch Petersen [1982](#)). Its surface had been smoothed and was decorated with geometric motifs of an animal and the outline of what has been interpreted as a human being (Figure 32), a

sleeping shaman or a shaman in a trance, possibly used in connection with a hunting ritual. The human and animal are covered by parallel incised lines, which may represent skins (Andersen [2001](#)).



Figure 33: A selection of amber pendants from Denmark. Some objects exhibit engraved lines similar to the pendant found at Star Carr. Others demonstrate the drilling technique to produce lines of dots (Photograph by Arnold Mikkelsen, Nationalmuseet, CC BY-SA <http://samlinger.natmus.dk/DO/9628>)

In terms of pendants, a total of 73 decorated amber pendants have been found in Denmark, Skania in Sweden and Holstein in northern Germany (Toft and Brinch Petersen [2016](#)) (see Figures 33 and 34 for examples). Of these, the majority are stray finds (e.g. Fischer and Vang Petersen [forthcoming](#); Nielsen [1982](#)) and only seven are derived from *in situ* contexts: five from Zealand and one each from Jutland and northern Germany (Andersen [1998](#); Andersen *et al.* [1982](#); Fischer and Vang Petersen [forthcoming](#); Hartz [1998](#); Henriksen [1980](#); Toft and Brinch

Petersen [2016](#); Vang Petersen [2016](#)). Although these pendants have been made from amber, antler and bone have also been used (Andersen [2001](#); Gramsch [2014](#)). The pendants are perforated and often polished, which may have resulted from preparation before decoration, handling and use in antiquity (Andersen [2001](#)) or water rolling (Vang Petersen [2016](#)). Some also have faint grooves present (Andersen [2001](#); Vang Petersen [2016](#)) which researchers have argued indicates that these objects were attached to a cord and worn around the neck as pendants or amulets (e.g. Clark [1936](#); Gramsch [2014](#); Toft and Brinch Petersen [2016](#); Vang Petersen [2016](#)), although this conjecture is far from certain.



Figure 34: A close-up of some of the amber pendants from Denmark that exhibit the engraving method and the barbed line technique. Perforations at the top, presumably made in order to hang the pendants, have broken. Note also that the pendant on the left has two perforations, which is similar to the amber pendant found at Star Carr (Photograph by Arnold Mikkelsen, Nationalmuseet, CC BY-SA <http://samlinger.natmus.dk/DO/9661>)

A range of markings were produced using three techniques: boring, carving and incision (Clark [1936](#)). These techniques have been observed on objects from sites dated throughout the Mesolithic in Denmark: from the Maglemose (Early Mesolithic), the Kongemose (Middle Mesolithic) and

Ertebølle (Late Mesolithic). Markings include variations on lines and barbed lines, chevrons, net patterns, chequer patterns, lozenges, variations of cross-hatched lines, and hachured triangles (Clark [1936](#); Nash [1998](#)).

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6.2. Overview of art in Britain

Although far from ubiquitous, decorative artwork is (sparsely) distributed throughout the archaeological record of the British Mesolithic, both spatially and temporally. Geometric patterns incised into material culture can be found on artefacts across the British Isles from Camas Daraich, Skye (Clarke *et al.* [2012](#)), to Rhuddlan, Denbighshire (Quinnell *et al.* [1994](#)), Trevoose Head, Cornwall (Smith and Harris [1982](#)) and Hammersmith, London (Smith [1934](#)) (Figure 35). In addition to this, sculpture 'in the round' has been demonstrated through a stylised shale phallus from Nab Head, Pembrokeshire (David and Walker [2004](#)), while an Early Mesolithic date has been suggested for two instances of incised cave art at Aveline's Hole and Long Hole, Somerset (Mullan and Wilson [2007](#)).



Figure 35: (1) Decorated

bone adze, Hammersmith; (2) Decorated antler tine, Romsey; (3) Stone phallus, Nab Head; (4) Stylised Venus, Nab Head; (5) Incised motif on cave wall, Aveline's Hole; (6) Incised motif on cave wall, Long Hole; (7) Incised pebble, Trevoise Head; (8) Incised pebble, Camas Daraich; (9) Incised pebble SF1, Rhuddlan; (10) Incised pebble SF2, Rhuddlan; (11) Incised pebble SF5, Rhuddlan; (12) Incised pebble SF4, Rhuddlan; (13) Incised pebble SF6, Rhuddlan; (14) Incised pebble SF3, Rhuddlan; (15) Incised pebble B127, Llandegai

Chronologically, dating evidence suggests that art is distributed throughout the Mesolithic. Accelerator Mass Spectrometry (AMS) radiocarbon determinations place artistic activities in the 9th, 8th and 7th millennia cal BC (see Table 1). However, at present, only the Llandegai pebble can potentially be linked to the 6th and 5th millennia cal BC, unlike in northern Europe where art exists during Late Mesolithic, Ertebølle contexts (Andersen [1981](#); [2001](#)).

Table 1: Dates of Mesolithic art found in the British Isles. Raw dates from original publications calibrated using Oxcal 4.2 and r% IntCal 13

Site	Type	Date	Calibrated	Dating notes
Hammersmith, London	Incised bone tool	OXA-17128 8505±45 BP	7596-7508 cal BC	Direct AMS date on decorated artefact
Romsey, Hampshire	Incised antler	OxA-17161 8517±40 BP	7595-7522 cal BC	Direct AMS date on decorated artefact
Aveline's Hole, Somerset	Incised cave art	Multiple	8460-8140 cal BC	Modelled date for the cessation of activity and sealing of the cave - potential to be earlier
Long Hole, Somerset	Incised cave art	?Early Mesolithic	No associated dates	Early Mesolithic material within the cave
Nab Head, Pembrokeshire	Shale beads and sculpture	OxA-1495 9210±80 BP OxA-1496 9110±80 BP	8623-8283 cal BC 8567-8021 cal BC	
Rhuddlan M, Denbighshire	Incised pebble	BM-822 8528±73	7728-7426 cal BC	Date on bulked hazelnut fragments from within feature M90 containing one of the pebbles. Associated microliths

				suggest this may be too young.
Trevose Head, Cornwall	Incised pebble	Mixed Meso/Neo context	No associated dates	
Camas Daraich, Skye	Incised tool	7545±55 BP 7574±75 BP	6481-6251, 6591-6254 cal BC	Dates cited in Clarke <i>et al.</i> (2012 , 3)
Llandegai, Bangor	Incised pebble		4100-3900 cal BC	Inferred from association with rod microlith and Early Neolithic pottery (Griffiths 2014 ; Lynch and Musson 2001)

While several authors note the presence of these expressive practices within Mesolithic Britain, few have offered interpretations for the meaning behind these actions. By far the most debated piece of material culture in relation to British Mesolithic art is the Nab Head shale 'amulet'. The original excavator rather prudishly described this as a 'duck-head' (although later conceded that it may in fact be a 'venus phallica' (Gordon-Williams [1926](#)). Abbé Breuil took an interest in the object noting the similarities to both a phallus and the hips and waist of a woman. This led Breuil to interpret it as a coded *jeu de mots*, blending references to gender and fertility (Breuil [1955](#)). Jacobi ([1980](#)) identifies a further piece of shale within the Nab Head assemblage that shows signs of working, and he links this to more stylised representations of the female form. The context of deposition of the Nab Head 'phallus' has also been noted,

apparently having been placed into the ground alongside nine shale beads (Chatterton [2003](#)).

Clark (Clark [1936](#)) linked the chevrons observed on the Romsey decorated antler and Hammersmith bone adze to similar artistic patterns from across Europe. He states that they were created through incision with a fine and sharp tool, and that these methods of decoration are exemplified by the assemblages of Sværdborg and Holmegård in Denmark (Clark [1936](#), 162). These form part of a wider group of bone and antler artefacts featuring 'single chevrons often one placed above another' which are 'scattered indiscriminately over the whole of the North European plain' (Clark [1936](#), 172). However, owing to the isolated nature of this form of osseous material culture decoration within Britain, Clark was unable to draw any more meaningful parallels between the British examples and other sites, and only included them in his consideration of art on the basis of 'conjecture' (Clark [1936](#), 162).

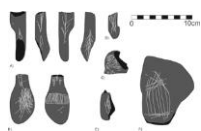


Figure 36: The Rhuddlan incised pebbles. (A) SF1; (B) SF2; (C) SF3; (D) SF4; (E) SF5; (F) SF6

Berridge (Berridge and Roberts [1994](#)) provides some of the most detailed and direct discussion of the artwork from Rhuddlan, linking the finds from secondary deposits with an example from a dated Mesolithic context through the microscopic study of the methods of decoration (Figure 36). He notes that two distinct clusters of incised lines on SF1 and SF2 can be considered as 'motifs' for the sake of analysis - and that the form of these motifs have very close parallels elsewhere in Mesolithic Europe. He contests Miles' ([1972](#)) earlier suggestion that, in its entirety, SF2 can be

interpreted as an anthropomorphic figure with clothes, as this bucks the broader trend of north-west European Mesolithic art. This interpretation requires a consideration of the overall form of the pebble as well as the separate motifs working together to form a complete, stylised figure - two characteristics that are deemed atypical of the wider body of Mesolithic artwork. Jacobi (pers. comm. in Berridge and Roberts [1994](#)) tentatively suggests that the shape depicted on SF6 may reference a fish trap, and notes the strong formal similarity between this specific design and the structure of wooden fish traps from the Late Mesolithic sites of Lille Knabstrup and Nidløse, Zealand in Denmark.

Clarke *et al.* ([2012](#)) provide a methodical discussion of a series of lines incised along the edges of a bevelled pebble tool from Camas Daraich, Skye. They note the lack of similarities between the form of the incisions and the more widely recognised net patterns, zoomorphs or anthropomorphic figures observed elsewhere in European Mesolithic artwork. They also note that the lines are unlikely to communicate individual ownership, as these areas would be covered and thus invisible if the object were hafted or bound. Instead, they lean towards the incisions being representations of binding; guides for where and how an object should be bound which serve a quasi-functional purpose in providing purchase for binding materials. While this interpretation is presented tentatively, Clarke *et al.* ([2012](#)) note the lack of discussion of many of these themes within broader discourses of the British Mesolithic.

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6.3 The Star Carr pendant in the context of the European evidence

The Mesolithic art found so far in Britain has been created by incision, probably with a sharp piece of flint, possibly with the tip of a microlith or bladelet. Two pieces are incised on bone and antler but the majority are incised on stone, mainly pebbles. It is noteworthy that art also appears in caves in Britain, in the form of lines. The lines of the Star Carr pendant are unlike any other examples from Britain in that they appear more formally executed, with carefully patterned small lines running tangential to some of the longer lines. This is a pattern also found on examples from Denmark and perhaps strengthens the argument made for other 'Maglemosian' type artefacts, such as the amber pendant, barbed points and headdresses, recovered from Star Carr, that there was a strong connection over long distances at this time. What is particularly noteworthy is that pendants with the barbed line motif mostly have a western distribution (Toft and Brinch Petersen [2016](#)), suggesting specific connections around the North Sea, or Doggerland region (Vang Petersen [2016](#)).

This artefact is unique in a British context in that it can be classed as a decorated pendant due to the perforation, rather than a pebble. In this respect, it is very similar to a number of the northern European examples. Unlike those in Denmark which tend to be crafted from amber, this example stands out because it is made from shale. It is also one of the

few decorated pendants that have been found within an archaeological context and not as a stray find.

In summary, this example of Mesolithic art has some similarity to other pieces from Britain in that lines have been engraved, but in fact, it is much more similar to the Danish examples in terms of the barbed line patterning and the object itself. It is the earliest known Mesolithic art in Britain, dating to about 9000 BC and is therefore likely to be at least 500 years earlier than the examples from Nab Head and Aveline's Hole.

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7. The Biography of the Pendant

The pendant has been crafted out of a piece of shale, probably utilising the natural form of the pebble, as opposed to being worked into its current shape. No manufacturing traces were visible on the surface or edges, but given the post-depositional surface modification [discussed earlier](#), these may no longer be visible. Pieces of shale of varying shapes are found locally both at the coast and closer to the lake eroding out of the underlying glacial till in ditches and river banks. There is of course the possibility that the shale pendant was brought to Star Carr from further afield.

One of the unresolved questions concerns the precise point at which the perforation was made: was it the first modification to this piece of shale or one of the last? The argument for the first phase comes from the logic that the artwork respects the placing of the hole and that a hole is likely to have been made first because of the possibility of breaking the object during the perforation process.

There is tentative evidence that the pendant was used; however, the microwear evidence is inconclusive, though a slightly brighter area on the vertex may be indicative of it having been strung. We cannot rule out that this pendant was worn, but either for such a short duration of time that no wear traces developed, or that they have since been obscured by post-depositional surface modification. The lines themselves are very faint and

there is no evidence that they were accentuated with colour. This may indicate that the engravings were not intended to be clearly visible.

The engravings suggest two possible phases with two different types of markings. It is impossible to say how long the process of engraving took and how many people may have added to it. There could, for example, be at least two hands at work producing the two distinctive sets of lines: maybe members of the same social group, maybe friends, or maybe even different members of the same family. Similarly, what these lines mean is open to speculation. Different interpretations from those who have seen it have included a tree, a map, a leaf, tally marks, even a representation of the wooden platforms which have been found at Star Carr. Why *this* particular piece of shale was decorated in the first place is also an interesting question when other stone beads at Star Carr and more broadly across Britain are not decorated.

The other noteworthy mark on the artefact is the nick on the non-engraved side. There is no visible evidence for how it was made, though it must have been made by some form of percussion (Peter Rawson personal communication 2015), either accidental damage, or perhaps deliberately damaged prior to deposition in this context (Toft and Brinch Petersen [2016](#)). However, it may also date to before the raw piece of shale was collected and turned into a pendant. It is likely that the nick was made before or at the moment that the pendant was deposited in the lake edge deposits, evidenced by the clustering of iron pyrite which has probably accumulated within this feature since deposition into the peat.

Finally, it is impossible to say who made, possibly wore, then deposited this pendant. It is noteworthy that it comes from an atypical context that has produced significant numbers of antler frontlets, also termed headdresses, interpreted to have been used by shamans. One possibility is that this pendant was also part of ritual paraphernalia used by a shaman, or considered to be some sort of amulet (e.g. Clark [1936](#); Vang Petersen [2016](#)). It is also possible that it was deposited intentionally into the lake as a way of ending its use life, as has been suggested for Danish pendants (Toft [2009](#); Vang Petersen [2016](#)).

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8. Conclusions

Through integrating a broad variety of scientific and imaging techniques to study this engraved pendant, displaying the earliest recorded art in Mesolithic Britain, we have developed an in-depth understanding of its likely source, production, method of engraving, and its depositional context. Detailed insights into the phasing of the lines engraved across its surface allow us to consider the temporality and compositional planning involved in the production of the art.

A battery of scientific methods was used to detect any residues that may have been applied to enhance the engraving. This work revealed that no such residues were applied, or at least, have not survived. What it did show was that pyrite, sand and micro-organisms identified during the analyses can be attributed to the pendant's depositional context. Because of the bright sheen produced by pyrite and PDSM, use-wear analysis was unable to provide definitive evidence that it had been strung, but considering how unique and symbolic an object this is, it may only have been worn for a special occasion, leaving no detectable wear traces. This interpretation may have resonance with the possibility that the design was engraved in a short period of time, and the unusual context in which it was found. In this case, it is possible to consider the making, use and deposition of this object happening in quick succession. A further curiosity is the nick on the non-engraved surface. We have been unable to

determine whether this was made intentionally but the presence of pyrite within the nick demonstrates that it happened in antiquity.

On contextualising the art on the Star Carr pendant within the broader evidence for art in Mesolithic Britain and Denmark, the latter producing the largest collection of Mesolithic art in Europe, we discovered that both the engravings - in particular the distinctive barbed lines of Clark's type C - and the choice of pendant form are closely aligned with what is known from southern Scandinavia. However, it is important to acknowledge that despite the broad spectrum of scientific analyses applied to this object, revealing new and unprecedented insights into its making, some artefacts will remain enigmatic; we can only speculate as to what the art represents, and what the production and possibly wearing and display of this object meant to the people living along this lake edge during the ninth millennium BC.

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